

REMARKS/ARGUMENTS

Claims 29-45 remain pending. No claims are amended or canceled by this response.

Embodiments in accordance with the present invention relate to methods of finishing silicon on insulator (SOI) substrates/wafers, and in particular to methods in which an etching treatment is performed on a cleaved surface. Pending independent claims 29 and 41 recite:

29. A dry method for finishing SOI substrates, said method comprising:
providing an SOI substrate comprising a cleaved surface, said cleaved surface having a first surface roughness value;
performing a hydrogen treatment to increase a concentration of hydrogen of said cleaved surface; and
performing an etchant and thermal treatment after the hydrogen treatment .
... (Emphasis added)

42. A dry method for finishing SOI wafers, said method comprising:
providing an SOI wafer comprising a main surface that has been cleaved, said cleaved main surface having a first surface roughness value;
performing a hydrogen treatment to increase a hydrogen concentration of said cleaved main surface; and
performing an etchant and thermal treatment after the hydrogen treatment .
... (Emphasis added)

These independent claims have been rejected under 35 U.S.C. § 103(a) as obvious over U.S. Patent 6,251,754 to Ohshima et al. ("the Ohshima patent") in view of Moriceau et al., "Hydrogen annealing treatment used to obtain high quality SOI surfaces", IEEE Intl SOI Conference Proceedings 37-38 (1998) ("the Moriceau article") in combination with U.S. Patent 5,141,878 to Benton et al. ("the Benton patent"). These claim rejections are overcome as follows.

In order to establish a prima facie case of obviousness, the Examiner is respectfully reminded that:

there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. (MPEP 2143).

The teaching or suggestion to make the claimed combination must be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488 (Fed.Cir. 1991).

Here, the references being relied upon by the Examiner contain absolutely no motivation for their combination. Specifically, the pending claims of this application relate to formation of silicon-on-insulator (SOI) semiconductor substrates. Such SOI substrates are typically fabricated by an independent manufacturer dedicated to this task, under specialized conditions and utilizing particular techniques and tools. For example, the starting materials for a SOI substrate manufacturing process typically include multi-layered wafer or substrates, including but not limited to silicon-on-silicon, silicon-on-oxide, and silicon-on-nitride, and silicon-on-quartz. Fabrication of a SOI substrate from these multi-layer materials typically involves a process of ten or fewer steps, which must be carried out under conditions that ensure global uniformity over the entire wafer surface. Examples of major manufacturers of SOI substrates include but are not limited to Soitec, MEMC, Walker Siltronic, and SEH.

Once formed, the SOI semiconductor substrate is then typically sold to members of a different industry group that are responsible for fabricating active electronic devices on the substrate, and then dicing the substrate into individual chips. The process for fabricating the active electronic devices typically involves a flow of more than fifty, and often more than a hundred, consecutive steps formed under precisely monitored conditions and affecting local areas of the substrate.

Examples of major chip manufacturers include but are not limited to Intel, Advanced Micro Devices, IBM, and others. Few of these chip manufacturers also create the substrates that are the starting materials for the semiconductor chips.

Applicants do not dispute that two of the references relied upon by the Examiner (the Ohshima Patent and the Moriceau Article) do relate to the field of substrate manufacturing. However, the Benton Patent - the third reference relied upon by the Examiner - does not bear any relation to the field of manufacturing SOI substrates.

Specifically, the Benton Patent describes fabrication of a particular type of electronic device on a substrate that has already been provided. In particular, the Benton Patent teaches creation of a photodiode structure that is monolithically integrated with other active electronic devices in the same semiconductor substrate. There is absolutely no teaching in the Benton Patent regarding manufacture of that substrate material, which in any event is specified as being

a silicon substrate, not a silicon-on-insulator (SOI) substrate that is the subject of the pending claims.

And while the Benton Patent does describe exposing a silicon surface to etching conditions, that surface is not the detached SOI surface of the Ohshima Patent. Rather, in the Benton Patent, side walls and a bottom of a tub already created in a single crystal substrate, are etched locally, in preparation for localized epitaxial growth of silicon in the tub to form a P/N junction:

the p-n junction is formed by epitaxially growing thin, doped layers of silicon on the peripheral surfaces. As preliminary steps, the entrenched wafers can be subjected to a combined high temperature pre-bake and HCl--H₂ gas etch to reduce native oxide films and to further smooth the bottom and side walls of the tub. A five minute pre-bake and etch at 1025°C using 0.9 l/m of HCl and 40 l/m of H₂ is exemplary. (Col. 2, lines 46-53)

This excerpt comprises the entire disclosure of the Benton patent regarding treatment of a substrate surface under etching conditions. The Benton patent includes no information that would reasonably lead one of ordinary skill in the art to perform such etching treatment globally upon the detached surface of the SOI substrate of the Ohshima patent. For example, the Benton patent provides no ranges, or even numerical values, for changes in surface roughness of tub side walls or bottom surfaces to be achieved utilizing HCl-H₂ exposure. In view of the Benton patent's omission of such information, it is difficult to understand how one of ordinary skill in the art would reasonably have been motivated to look to combine the Benton patent with the Ohshima patent.

Accompanying the filing of this response is the signed declaration of inventor Sien Kang. Mr. Kang's declaration emphasizes that one of ordinary skill in the instant art of substrate manufacturing, would not have been motivated to turn to the different art of chip manufacturing, in order to duplicate the invention. Specifically, Mr. Kang emphasizes the separate nature of the substrate and device manufacturing disciplines, including the fundamental differences in their objectives and the techniques relied upon.

Based upon the above arguments and the attached declaration, it is clear that art relied upon by the Examiner fails to teach or suggest its combination to reject the pending claims. Of course, consideration of the instant application provides ample suggestion regarding performing

etching treatment to a cleaved surface of an SOI substrate. However, the Examiner is strongly cautioned against relying upon Applicants' own disclosure to provide motivation to combine references:

[t]he tendency to resort to "hindsight" based upon applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art. (Emphasis added; MPEP 2142).

This strict prohibition against the use of hindsight, coupled with the lack of any apparent motivation in the Benton patent for its combination with the Ohshima patent, renders improper any conclusion of obviousness conclusion based upon these references.

Finally, it is noted that other references also relied upon by the Examiner to reject pending claims, fail to teach or suggest performing an etchant treatment in the manner of the pending claims. For example, the article to Tate et al. discloses annealing a surface in the presence of hydrogen, but utterly fails to teach or even suggest the "etching treatment" step of the claimed embodiments.

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance and an action to that end is respectfully requested. If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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